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FOSSIL EVIDENCE OF WIDER POST-PLEISTOCENE RANGE FOR BUTTERNUT AND HICKORY IN WISCONSIN

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The historic background of the present ranges of forest trees has not been fully explored by paleoecological studies of peat. At present there are probably over two hundred peat deposits that have been investigated in the United States and Canada, but a critical compilation of the data is difficult. The reasons which have prevented a thorough investigation of this sort are the unsatisfactory manner in which many of the studies have been reported, the probable errors in identification of certain fossils, and the difficulty in determining the historical age of many deposits. The recent "clock diagrams" by Smith and Sears (Sears, 1941), dealing with the migrations of certain forest elements, give a more related picture of the Quaternary forests than has heretofore been presented. Such studies appear very promising and should lead to the discovery of many interesting details of forest history.

While investigating the peats of northcentral Wisconsin the writers encountered fossil pollen of butternut (*Juglans cinerea*) and hickory (probably *Carya cordiformis*) in a bog that is now about fifty miles east of the present range of butternut and ninety miles north of the present range of hickory in that state. *Juglans* fossils occur vertically through three feet of peat and *Carya*

¹ From Coe College and the Limnological Laboratory of the Wisconsin Geological and Natural History Survey. Notes and reports No. 110.

through four feet. The fossil grains of these species are abundant in the peat even though they occur as a relatively small part of the total fossil count. They have not been found in the surface peat, which would be expected if the fossil pollen was wind-borne from the far distant locations of the present living trees. Therefore they strongly suggest a more eastern range for butternut and more northern range for hickory than is now evident on the maps published by Fassett (1932) depicting the extensions of range of modern species.

The difficulty in determining species of pollen in certain tree genera is well known to paleoecologists. Overlapping of size frequencies, variations in exine and structure within species, and differential preservation in peat all tend to make identification complex. Nevertheless, certain pollens in this study have been, temporarily at least, classified as to species. This has been done where good specific characters exist for the species in the region, or where only one species of the genus grows within or near the region of Vilas County, Wisconsin. *Juglans cinerea* and *Carya cordiformis* have characters which, according to Wodehouse (1935, pp. 355, 359), separate them from *Juglans nigra* and *Carya ovata*, the only other two species in Wisconsin having approximately the same geographic range; also, they are the northernmost species of their respective genera in Wisconsin.

The peat deposit reported here is located one and one-half miles north of Winchester, Vilas County, Wisconsin, in Section 5, Township 43 N., Range 5 E. The deposit is a few acres in extent and is six and one-half feet deep. The topography is morainal, and is described by Thwaites (1929) as part of the Winegar moraine [Wisconsin substage 4]. The soils in the immediate area are gravels, sandy loams, and clays. The virgin forest was white pine, hemlock, white birch, yellow birch, white spruce, hard maple, red oak, and basswood. Today, the forests are second growth trees consisting largely of white birch, aspen, and white pine. The bog has a partial cover of black spruce and a deep mat of *Sphagnum* moss over its surface. Other typical bog plants occur on it in abundance.

The peat samples were collected from the deepest part of the bog after it was thoroughly sounded. They were collected with a Davis peat sampler from vertical intervals of six inches. The

peat was prepared in the usual manner employed by paleoecologists and a statistical analysis was made of the fossils. A count of one hundred fossils was made at the basal level, and two hundred were counted at other levels, except at the one-foot level where fossils were very abundant and it was desirable to count three hundred. From these counts the percentages in Table 1 were determined, and the diagram (Fig. 1) was constructed. In addition to the fossils counted, the levels where the butternut and hickory were found were further studied to determine the

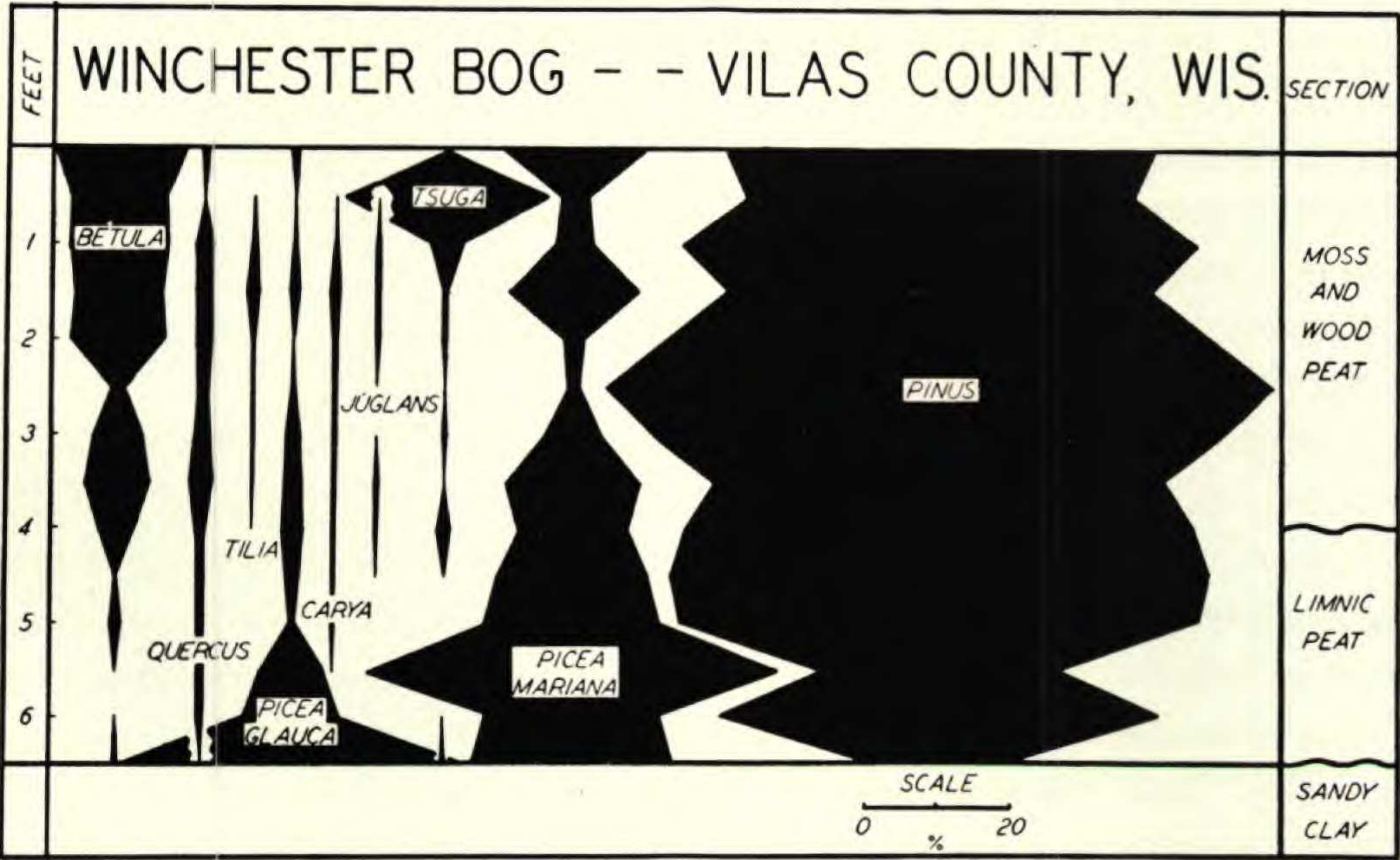


FIG. 1. Pollen-diagram showing microfossil succession and relative abundance of significant tree-species in the Winchester Bog.

actual instead of the relative abundance of the fossil pollen of these and other species.

As noted above, fossil pollen of *Juglans* and *Carya* was found to be fairly abundant, though pollen of either species appears as only .5 to 1.5 per cent of the total count. In regions of pine and spruce, hardwood pollen in the peat on the bog surface is greatly overshadowed by conifer pollen even though hardwoods are abundant in the vicinity. This would indicate that a small percentage of hardwood pollen in a spectrum dominated by conifers is very significant and denotes greater abundance of hardwood trees than would appear on first consideration. This is borne out by the fact that in Table 1 where is shown the rela-

tive abundance of tree pollen based on a count of two hundred fossils, only *Betula* and *Quercus* appear at the surface, whereas *Acer*, *Tilia*, and *Fraxinus* are also known to be living in the vicinity. When the surface sample was studied more fully, these species of fossil pollen were found to be present, and would have been recorded if more than the customary two hundred fossils had been counted. It would seem that for the purpose of securing a qualitative analysis of the ancient forests more than one hundred and fifty to two hundred fossils should be counted. The counting of the above number has been considered adequate by most paleoecologists for determining successional trends of the early forests. For a more thorough understanding of the composition of the forest as indicated at any one level in the peat bog, it might be better to count enough fossils to establish the presence or absence of particular species in the sample. Just what this number should be, the authors are

TABLE 1. PERCENTAGES OF FOSSIL POLLEN IN THE WINCHESTER BOG, VILAS COUNTY, WISCONSIN

Species	Depth in Feet												
	6.5	6.0	5.5	5.0	4.5	4.0	3.5	3.0	2.5	2.0	1.5	1.0	0
<i>Abies balsamea</i>					1.0	3.0	2.0	.5	1.0	1.5	1.5		2.0 1.0
<i>Picea glauca</i>	4.5	13.0	9.0	1.0	2.0	3.0	2.5	2.0	.5		1.5	.5	1.0
<i>Picea mariana</i>	47.0	24.0	56.0	24.0	21.0	15.0	18.5	8.0	2.0	3.0	18.0	5.5	4.0 20.0
<i>Pinus Banksiana</i>	27.5	29.0	4.0	7.0	8.0	4.0	8.0	12.0	4.0	6.0	5.5	2.0	8.0 3.0
<i>Pinus resinosa</i>	7.5												
<i>& Pinus Strobus</i>	11.5	31.0	28.0	64.0	65.5	65.5	53.5	66.0	87.0	69.0	52.5	68.5	45.0 56.0
<i>Betula</i>	.5			1.5		5.0	9.0	7.0	2.0	13.0	12.0	13.5	13.0 18.0
<i>Tsuga canadensis</i>	.5					2.0		.5		.5	.5	4.5	28.0 1.0
<i>Quercus</i>		1.0	1.0	1.0	1.0	1.0	2.5	2.0	1.5	2.0	2.0	2.5	
<i>Ulmus americana</i>	.5	2.0	1.0	1.0	1.0	.5	1.0	.5	.5	1.0	.5	.5	
<i>Acer</i>	.5		1.0				1.5	.5	.5	2.0	1.5	.5	
<i>Juglans cinerea</i>				.5	.5	.5	.5	.5	.5	.5	.5	.5	
<i>Carya cordiformis</i>						.5	.5	.5	.5	.5	1.5	.5	
<i>Fraxinus</i>				.5	.5	.5	.5	.5	.5	.5	.5	.5	
<i>Tilia americana</i>						.5	.5	.5	.5	.5	2.0	.5	

not able to state. This might vary with the pollen frequency, the abundance of conifer pollen, and the type of peat.

An examination of the table and diagram indicate a postglacial forest history of the following order: (1) white and black spruce dominant with some pine and balsam fir; (2) pines dominant with a mixture of oak, hickory, butternut, birch, ash, maple, elm, basswood, fir, and hemlock; (3) pines dominant with birch, hemlock, spruces, fir, and oak. Except for the presence of butternut and hickory, this is the usual list of species in the forest history in northcentral Wisconsin. It is interesting to note an observation of Prof. L. S. Cheney (Fassett, l. c.) concerning the associated trees of the butternut hickory in the northern part of Wisconsin. He states, "The butternut selects as its home low, wet woods near the borders of streams and swamps, or high rolling uplands. It is commonly associated in our territory with hickory, the hackberry, the oaks, and in the northern part of the state with the yellow birch, basswood, and hard maples."

In the numerous other peat deposits of the same county examined by the writers and Mr. R. M. Kosanke, the existence of oak and other hardwoods is noted in levels comparable to those containing butternut and hickory. Though butternut or hickory pollen has not yet been found in these deposits, a forest somewhat similar to that containing these trees is suggested. Further examination of peat deposits south of Winchester should substantiate the discovery of butternut and hickory pollen in northern Wisconsin and give considerable information on the migration of these species. Care must be taken to make such studies in areas where exist suitable soils for butternut and hickory growth.

The discovery of butternut and hickory fossil pollen in a region considerably beyond the present living ranges of these species may have bearing on the question of earlier forest distribution. In southern and western Wisconsin there are isolated prairies that appear as relicts of more extensive areas. These are part of the prairie peninsula described by Transeau (1935) as extending eastward from Iowa and Illinois into Ohio. If the prairies of Wisconsin were in late postglacial time more extensive, it is probable that the oak-hickory forests of Wisconsin extended farther to the northward. Fuller (1927) states, "Certain studies of existing forests, notably those of Lee ('24) in Minnesota, also

seem to indicate that the spruce-fir climax is slowly invading the deciduous. It therefore seems safe to venture the opinion that the transition belt of the conifer-deciduous forest was perhaps some one hundred miles farther north towards the middle of postglacial time than at the present." The discovery of hickory in the Winchester peat approximately ninety miles north of its present-day range appears to be in agreement with this opinion. The southward movement of the forests and constriction of the prairie areas has been considered as supporting evidence for the Von Post hypothesis (1930) which postulates a period of decreased climatic warmth at present.

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THE PHYLOTAXY OF CATALPA

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Most descriptions of *Catalpa* and most keys to the genus emphasize the opposite arrangement of the leaves, while they do not mention the whorled arrangement at all, or it is given as a secondary condition. However, according to my observations covering many years, the leaves arise almost always in whorls of three, are only rarely opposite and are occasionally in whorls of four or alternate.